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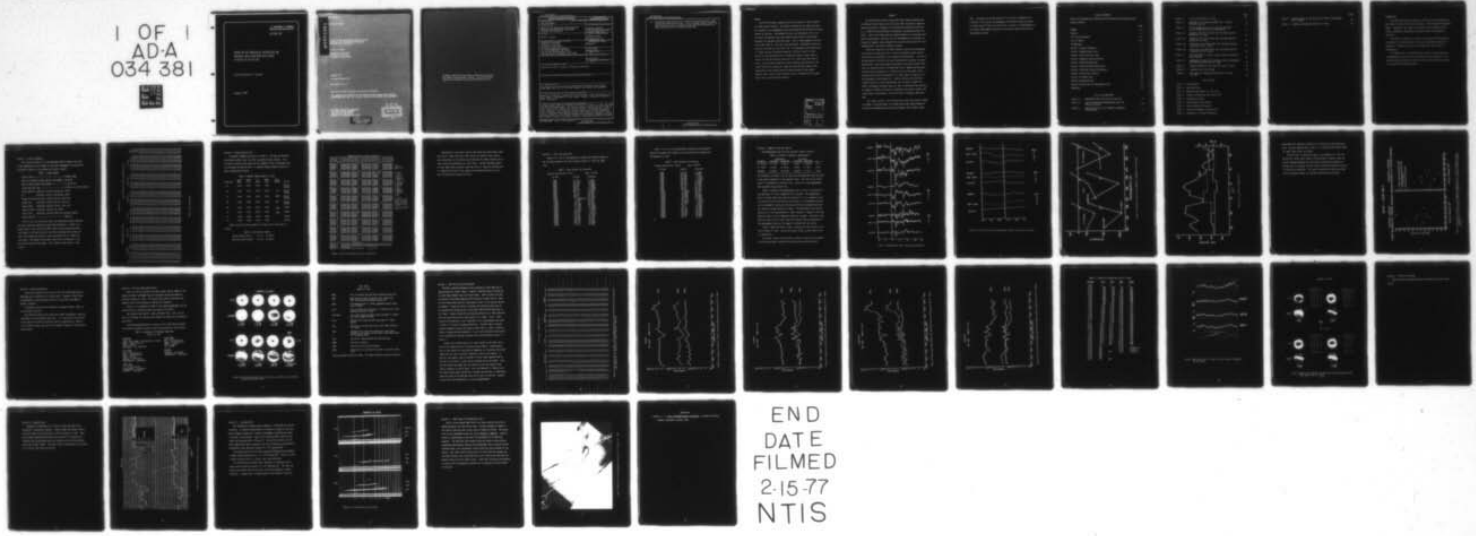

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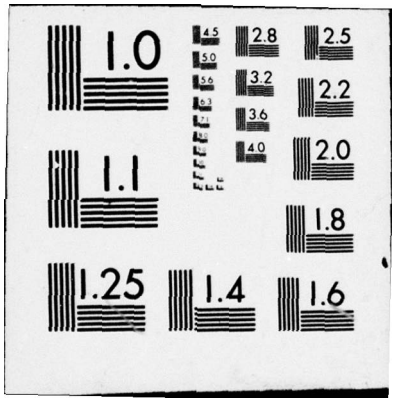
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REPORT ON THE GEOPHYSICAL DESCRIPTION AND AVAILABLE DATA ASSOCIATED WITH ROCKET PF-SH-92 (IC 519.07-1B)

ALASKA UNIVERSITY, COLLEGE

JANUARY 1976

AFGL-TR-76-0007

REPORT ON THE GEOPHYSICAL DESCRIPTION AND AVAILABLE DATA ASSOCIATED WITH ROCKET PF-SH-92 (IC 519.07-1B)

Gerald J. Romick

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Fairbanks, Alaska 99701

January 1976

Scientific Report No. 7

HAES Report No. 55

This research was sponsored by the Defense Nuclear Agency under Subtask L25AAXYX966, Work Unit 16, entitled "Analysis and Feasibility Assessment".

AIR FORCE GEOPHYSICS LABORATORY
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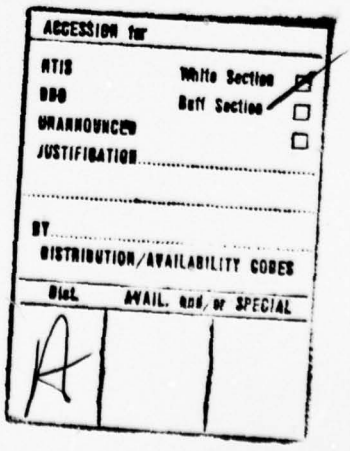
20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A Sargent Hydac rocket was launched at 07:48:10 UT on March 12, 1975 from Poker Flat Research Rocket Range. This rocket reached an apogee altitude of 194 km with a total flight time greater than 444 seconds. The payload was successfully recovered. The rocket was launched into auroral activity propagating south and westward from substorms occurring much farther to the east. The region was primarily at the boundary between the equatorward eastward electrojet and poleward westward electrojet, probably in the Harang discontinuity region.

20. The maximum intensity of 35 kR in 5577 was observed from Ft. Yukon during the launch around T+148. A more in-depth study of these data can be used to assist in determining the detailed relationship between the aurora and the on-board rocket data.

Summary

The PF-SH-92 rocket launched 07:48:10 UT, March 12, 1975, entered an active auroral display. The region traversed by the rocket was part of a system of arcs propagating south and westward from activity initiated farther to the east. The magnetic activity at College was -75γ in ΔH initially, recovering from a more negative period due to the passage overhead of a westward traveling surge. The Ft. Yukon magnetic activity varied from -250γ to -175γ over the same period. Absorption associated with this activity was less than 1 db. The photometric data obtained at Ft. Yukon indicates a maximum intensity of 35 kR in 5577 at T+148. Because of the characteristics of height and width of these types of aurora, the zenith intensity could be 2 to 3 times that seen from Ft. Yukon. The variations observed in both intensity and position of the aurora during this launch will complicate the detailed study of the association of the rocket data with those obtained on the ground. However, this initial review indicates that if warrented by the rocket data, such a study would be possible.



PREFACE

The High Altitude Effects Simulation (HAES) Program sponsored by the Defense Nuclear Agency since the early 1970 time period, comprises several groupings of separate, but interrelated technical activities, e.g., ICECAP (Infrared Chemistry Experiments--Coordinated Auroral Program). Each of the latter have the common objective of providing information ascertained as essential for the development and validation of predictive computer codes designed for use with high priority DoD radar, communications, and optical defensive systems.

Since the inception of the HAES Program, significant achievements and results have been described in reports published by DNA, participating service laboratories, and supportive organizations. In order to provide greater visibility for such information and enhance its timely applications, significant reports published since early calendar 1974 shall be identified with an assigned HAES serial number and the appropriate activity acronym (e.g., ICECAP) as part of the report title. A complete and current bibliography of all HAES reports issued prior to and subsequent to HAES Report No. 1 dated 5 February 1974 entitled, "Rocket Launch of an SWIR Spectrometer into an Aurora (ICECAP 72)," AFCRL Environmental Research Paper No. 466, is maintained and available on request at DASIAC, DoD Nuclear Information and Analysis Center, 816 State Street, Santa Barbara, California 93102, Telephone: (805) 965-0551.

This report, which is the seventh report under DNA Contract F19628-74-C-0188 is the 55th report in the HAES series and covers technical activities performed during the period November 1975 through January

1976. The purpose of the work herein is to provide a geophysical description of the auroral and geomagnetic environment during the launch of ICECAP rocket PF-SH-92 (IC 519.07-18); to assist in interpretation of the primary measurements obtained by the sensors onboard this specific experimental payload.

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Report on the Geophysical Description and Available Data Associated with Rocket PF-SH-92.

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LIST OF TABLES

INTRODUCTION

This report describes the general auroral activity associated with the launch of rocket PF-SH-92 on UT March 12, 1975 at Poker Flat Research Range. Included in this report are peripheral data pertinent to the launch, atmospheric meteorology and ground station instrumentation operation.

The format is arranged in sections to facilitate locating specific information on the various types of data and instruments that were in operation. Explanatory material is included with each section for completeness.

The summary that is presented pertains only to the description of the geomagnetic activity and our evaluation of the usefulness in proceeding to detailed absolute intensity and high time resolution studies of the available ground based data.

Section 1 - Launch Parameters

This section reviews all of the pertinent details known at the time of the preparation of this report on the launch parameters of the vehicle. The specific details of the launch are listed in Table 1.

TABLE 1 Launch Resume

Vehicle Type	Sargent Hydac
Poker Flat Research Range Vehicle Code Number	PF-SH-92
NASA or other Vehicle Code Number	IC 519.07-18
Launch Date and Time	UT March 12, 1975 07:48:10
Launch Azimuth	predicted, (actual setting) 45, (45.5)
QE	predicted, (actual setting) 83, (82.7)
Apogee Altitude	predicted, (actual) 194 km, (183.8 km)
Apogee Time	predicted, (actual) 229 sec (227 sec)
Impact Range	predicted, (actual) 176 km, (163.2 km)
Impact Azimuth	predicted, (actual) 45, (28.6)
Impact Time	predicted, (actual) (444 sec) recovery payload
Payload Weight	860 lbs.

Table 2 lists the rocket and field line observation angles obtained from the trajectory supplied by Space Data Corporation. Listed in 10 second steps in time after the launch (T+0) are the Azimuth and Elevation angles to the vehicle and to the 100 km intercept point along the field line through the rocket as seen from Poker Flat, Ft. Yukon and Ester Dome. The magnetic field model used in this calculation is the Pogo 10-65 internal field model. The altitude of the rocket is also listed.

LOOK ANGLE DATA

(sec)	ROCKET OBSERVATION ANGLES						100 km FIELD LINE INTERCEPT OBSERVATION ANGLES						
	ESTER DOME		POKER FLATS		FT. YUKON		ESTER DOME		POKER FLATS		FT. YUKON		
T+	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	ELEVATION	AZIMUTH	(km) ALT
060	19.4791	11.8424	76.1600	26.1920	29.2228	250.5312	33.1138	10.8315	86.8291	20.6502	41.9628	247.6291	88.17
070	23.5525	12.3918	75.6086	27.7633	36.1333	252.0225	31.8485	11.7961	82.5105	26.9703	43.6628	249.9928	73.15
080	26.7616	12.6823	74.6553	26.6421	41.9704	254.2610	30.5602	12.4147	78.0363	26.2647	45.3164	253.1812	67.03
090	29.3509	12.6785	73.9341	24.3342	46.6093	256.8463	29.4067	12.6746	73.9864	24.3264	46.6570	256.8281	65.80
100	31.5308	13.1972	73.2405	25.4524	50.9067	258.9476	28.3887	13.4111	70.1645	25.7671	48.3151	260.1164	111.78
110	33.5217	13.4525	72.1334	25.8133	54.2619	260.6812	27.6063	13.8868	67.2225	26.2337	49.5603	263.1294	122.03
120	34.8900	13.9016	72.3188	26.2188	57.3200	263.2744	26.7098	14.4329	63.8381	26.6740	51.0067	267.1026	133.09
130	36.0511	14.0819	71.7500	25.8289	59.6700	265.9013	25.9437	14.7288	61.0004	26.4098	52.0311	271.1372	142.29
140	36.7845	14.2242	70.8707	25.2690	61.6122	269.1619	25.1640	14.9570	58.1446	25.9651	52.8990	275.8033	150.20
150	37.7249	14.7440	70.6312	26.5311	63.5360	270.6895	24.6481	15.5385	56.1520	27.0447	53.9025	278.9933	157.52
160	38.1942	14.9852	69.9208	26.5178	64.9720	273.8559	24.0416	15.8261	53.9416	27.0419	54.6511	283.3209	164.28
170	38.0709	14.4979	68.5925	23.9109	65.4383	278.8966	23.2815	15.3987	51.3931	24.8856	54.1200	289.2469	169.01
180	38.7040	15.3465	68.5401	26.2954	67.0258	279.8533	23.0032	16.2461	50.2421	26.8650	55.3593	291.6027	174.37
190	38.4227	15.3493	67.2895	25.4992	67.5466	284.3225	22.3969	16.2579	48.1788	26.1878	55.1493	296.7732	177.50
200	38.5488	15.7959	66.8219	26.4216	68.3993	286.4333	22.0848	16.6949	47.0382	26.9444	55.6285	299.7493	180.65
210	38.1517	16.0844	65.6703	26.6114	68.8709	290.3462	21.6255	16.9587	45.4638	27.0823	55.6181	304.0876	182.16
220	37.6799	16.1317	64.5697	26.2052	68.9194	294.0809	21.2181	16.9922	44.1293	26.7288	55.1594	307.8159	182.88
230	37.2046	16.4534	63.5510	26.6304	69.1507	297.3093	20.8972	17.2778	43.0420	27.0639	55.1172	311.0671	182.87
240	36.6687	16.6289	62.5600	26.7103	69.1122	300.2600	20.6210	17.4230	42.1369	27.1149	54.8543	313.7671	182.15
250	35.7350	16.8240	61.0117	26.7019	68.7891	304.4257	20.2561	17.5698	40.9652	27.0819	54.3411	317.2588	179.91
260	34.8153	16.9841	59.5799	26.6997	68.3318	307.8945	19.9706	17.6835	40.0612	27.0562	53.8630	319.9599	177.07
270	33.7088	17.1475	57.9301	26.7013	67.6516	311.4545	19.6934	17.7926	39.1944	27.0307	53.3349	322.5443	173.09
280	32.5025	17.2999	56.1712	26.6998	66.7837	314.8272	19.4418	17.8877	38.4175	27.0012	52.7990	324.8435	168.33
290	31.3660	17.6342	54.5519	27.1918	66.1337	317.6612	19.2758	18.1585	37.8771	27.4179	52.7086	326.7659	163.27
300	29.8136	17.7875	52.3309	27.1912	64.7588	320.9736	19.0523	18.2433	37.2006	27.3897	52.1592	328.7597	156.37
310	28.2259	17.9238	50.0497	27.1913	63.2014	323.8828	18.8646	18.3122	36.6385	27.3623	51.6678	330.3954	149.03
320	26.3368	18.0655	47.2811	27.1809	61.1390	326.9547	18.6689	18.3768	36.0587	27.3204	51.1213	332.0511	140.14
330	24.3779	18.1991	44.3504	27.1805	58.7738	329.7083	18.5007	18.4329	35.5646	27.2866	50.6335	333.4453	130.73
340	22.4140	18.6115	41.3402	27.8009	56.5605	332.5425	18.3928	18.7647	35.2072	27.8547	50.6759	335.0221	120.96
350	20.2233	18.7452	37.9010	27.8303	53.3616	334.8558	18.2750	18.8179	34.8641	27.8562	50.3271	336.0092	110.13
360	17.6309	18.8794	33.6506	27.8210	49.0224	337.4343	18.1297	18.8612	34.4468	27.8144	49.8590	337.1533	97.41
370	14.9422	18.9691	29.0986	27.7753	43.8960	339.6741	18.0102	18.8744	34.1089	27.7370	49.4403	338.0220	84.09

TABLE 2 Look Angle Data

Section 2 - Meteorological Data

The weather summaries are given in Table 3. The data are obtained from either station logs, ASC data, or weather bureau records. Also included in Table 4 (next page) are the complete 3 hour climatology data for the month of March at the U. S. Weather Bureau Station at the Fairbanks International Airport.

TABLE 3 Weather Summary March 12, 1975

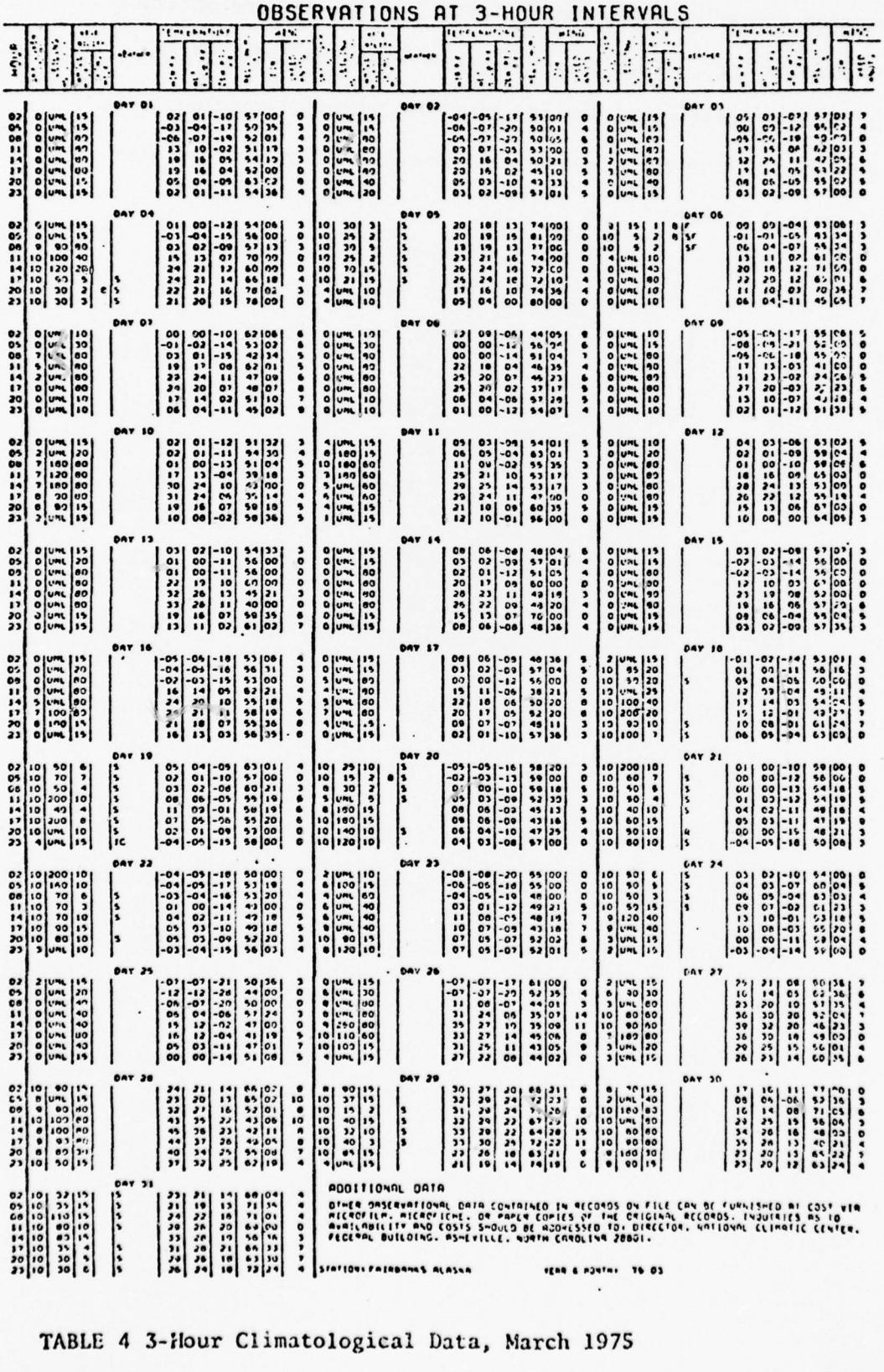
Time (UT)	Ester Dome	Poker Flat	Ft. Yukon	Mould Bay	Sachs Harbor	Inuvik
05	Clear	Clear	Clear	Clear		Partly Cloudy
06	Clear	Clear	Clear	Clear	NO	Partly Cloudy
07	Clear	Clear	Clear	Clear	DATA	Partly Cloudy
08	Clear	Clear	Clear	Clear	FOR	Partly Cloudy
09	Clear	Clear	Clear	Clear	THIS	Cloudy
10	Clear	Clear	Clear	Clear	TIME	Cloudy
11	Clear	Clear	Clear	Clear		Cloudy
12	Clear	Clear	Clear	Clear		Cloudy

Table 5 gives the wind parameters at Poker Flat at the time of launch.

TABLE 5 Wind Data at Launch

Surface Wind Velocity	3.1 m/s	Az 144.5°
Ballistic Wind Velocity	0.7 m/s	Az 218.2°

OBSERVATIONS AT 3-HOUR INTERVALS



NOTES

CEILING COLUMN-
UNL INDICATES UNLIMITED CEILING

WEATHER COLUMN-

- T THUNDER
- L DRIZZLE
- R RAIN
- RW RAIN SHOWERS
- ZR FREEZING RAIN
- S SNOW
- SW SNOW SHOWERS
- IP ICE PELLETS
- A HAIL
- F FOG
- IF ICE FOG
- GF GROUND FOG
- BD BLOWING DUST
- BN BLOWING SNOW
- BS BLOWING SAND
- BY BLOWING SPRAY
- K SMOKE
- H HAZE
- D DUST

WIND COLUMNS-

DIRECTIONS ARE THOSE FROM WHICH THE WIND BLOWS, INDICATED IN TENS OF DEGREES FROM TRUE NORTH (i.e., 09 FOR EAST, 18 FOR SOUTH, 27 FOR WEST, ENTER 00 FOR CALM IN THE DIRECTION COLUMN WHEN INDICATED CALM.

SPEED IS EXPRESSED IN KNOTS; MULTIPLY BY 1.15 TO CONVERT TO MILES PER HOUR.

ADDITIONAL DATA

OTHER OBSERVATIONAL DATA CONTAINED IN RECORDS ON FILE CAN BE FURNISHED AT COST VIA MICROFILM, MICROFICHE, OR PAPER COPIES OF THE ORIGINAL RECORDS. INQUIRIES AS TO AVAILABILITY AND COSTS SHOULD BE ADDRESSED TO: DIRECTOR, NATIONAL CLIMATIC CENTER, FEDERAL BUILDING, ASHEVILLE, NORTH CAROLINA 28801.

STATION: FAIRBANKS ALASKA YEAR & MONTH: 75 03

TABLE 4 3-Hour Climatological Data, March 1975

Examination of the ground station data shows that Ester Dome, Poker Flat and Ft. Yukon skies were clear during the launch of this rocket, thus corrections for extinction and scattering for these stations can be used, which are appropriate for clear skies. The MSP recording camera at Ester Dome failed; however, good data from Ft. Yukon was obtained and it, combined with the all-sky camera data from both stations, can be used to describe the auroral activity.

Section 3 - Solar and Lunar Data

Table 6 is a list of the geographic azimuth and elevation angles of the sun with respect to the true horizon on March 12, 1975 for Poker Flat.

TABLE 6 Solar Azimuth and Elevation

Station Location Lat = 65.13 Long = 147.48

UT Time	Azimuth	Elevation
0000	211.618	17.7943
1000	226.632	13.8345
2000	241.006	8.76802
3000	254.88	2.94828
4000	268.51	- 3.26565
5000	282.208	- 9.51805
6000	296.3	-15.4464
7000	311.071	-20.6707
8000	326.69	-24.7976
9000	343.117	-27.4543
10000	4.52709E-02	-28.3608
11000	16.9677	-27.412
12000	33.379	-24.7153
13000	48.9768	-20.5522
14000	63.7254	-15.2948
15000	77.7971	- 9.33594
16000	91.4792	- 3.05379
17000	105.099	3.1903
18000	118.971	9.04116
19000	133.353	14.1406
20000	148.388	18.1316
21000	164.042	20.689
22000	180.079	21.5759
23000	196.117	20.7045
24000	211.777	18.1631

Table 7 is a list of the geographic azimuth and the elevation angles of the moon with respect to the true horizon for Poker Flat during March 12, 1975.

TABLE 7 Lunar Azimuth and Elevation

Station Location Lat = 65.13 Long = 147.48

UT Time	Azimuth	Elevation
0000	223.705	15.1684
1000	237.892	10.5973
2000	251.568	5.2315
3000	264.935	- .593154
4000	278.263	- 6.54417
5000	291.843	-12.2868
6000	305.941	-17.4758
7000	320.739	-21.7547
8000	336.27	-24.7762
9000	352.349	-26.2517
10000	8.59585	-26.0188
11000	24.5583	-24.09
12000	39.8885	-20.6469
13000	54.4496	-15.9839
14000	68.3118	-10.4419
15000	81.6853	- 4.36475
16000	94.8549	1.91671
17000	108.129	8.0792
18000	121.8	13.7958
19000	136.103	18.7286
20000	151.154	22.5364
21000	166.879	24.9102
22000	182.994	25.6332
23000	199.073	24.6426
24000	214.71	22.0514

Section 4 - Magnetic Data and Indices

The magnetometer data from the stations listed in Table 8

TABLE 8 Location of Magnetic Observatories

	Geographic		Invariant		
Location	Latitude	Longitude	Latitude	Longitude	L
Pt. Barrow	N 71.60	W 156.4	N 68.9	W 109.35	8.47
Ft. Yukon	N 66.57	W 145.25	N 66.9	W 95.3	6.50
College	N 64.87	W 147.80	N 64.75	W 95.7	5.49

are presented in Figure 1a on the same time and magnitude scale for each of the three components of the magnetic field. The time of the rocket launch is indicated by a vertical line. Figure 1b is the magnetometer data expanded around launch time.

Figure 1c presents the magnetometer data in terms of variations of the magnitude of Z and H components with latitude. The magnetometer data at College shows some negative excursion in ΔH in a generally zero or positive level of activity and illustrates that the westward electrojet lay between Pt. Barrow and College and that the eastward electrojet was south of College during this launch. The magnitude of the current density to a first approximation (∞ sheet current) in Amp/km is the same numerical value as the H component magnitude in gamma. The actual value may be as much as two or more times that deduced from the magnitude of the magnetometer data but the temporal variation will be similar.

Figure 2 shows the total K index, planetary Kp index and DST values for UT, March 12, 1975. During the rocket flight, K_p and K were 4 and 5, respectively.

The rocket flight occurred during a period in which ΔH was negative in the evening sector eastward electrojet during auroral activity

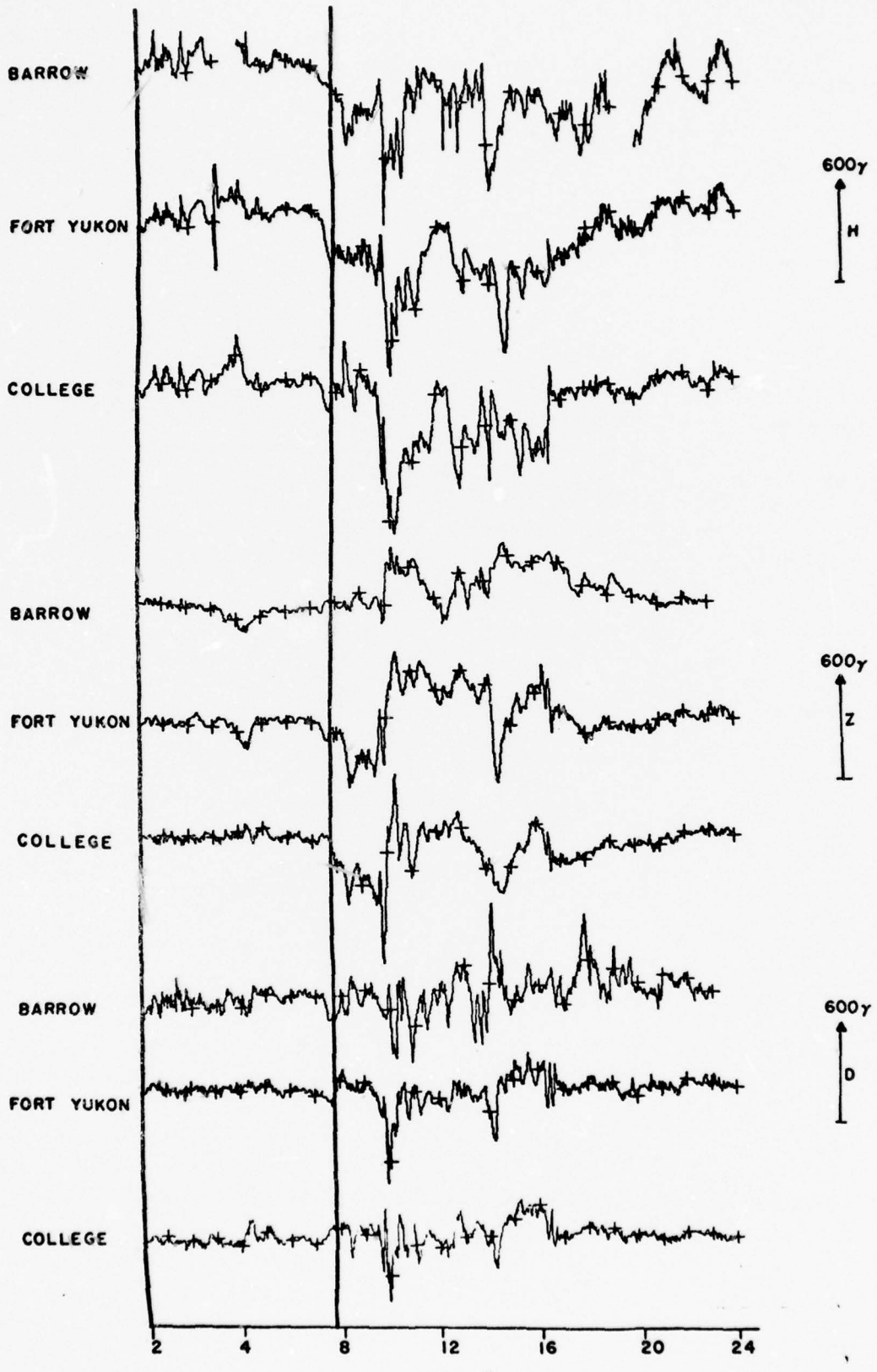


Figure 1a Magnetometer Data from Various Locations

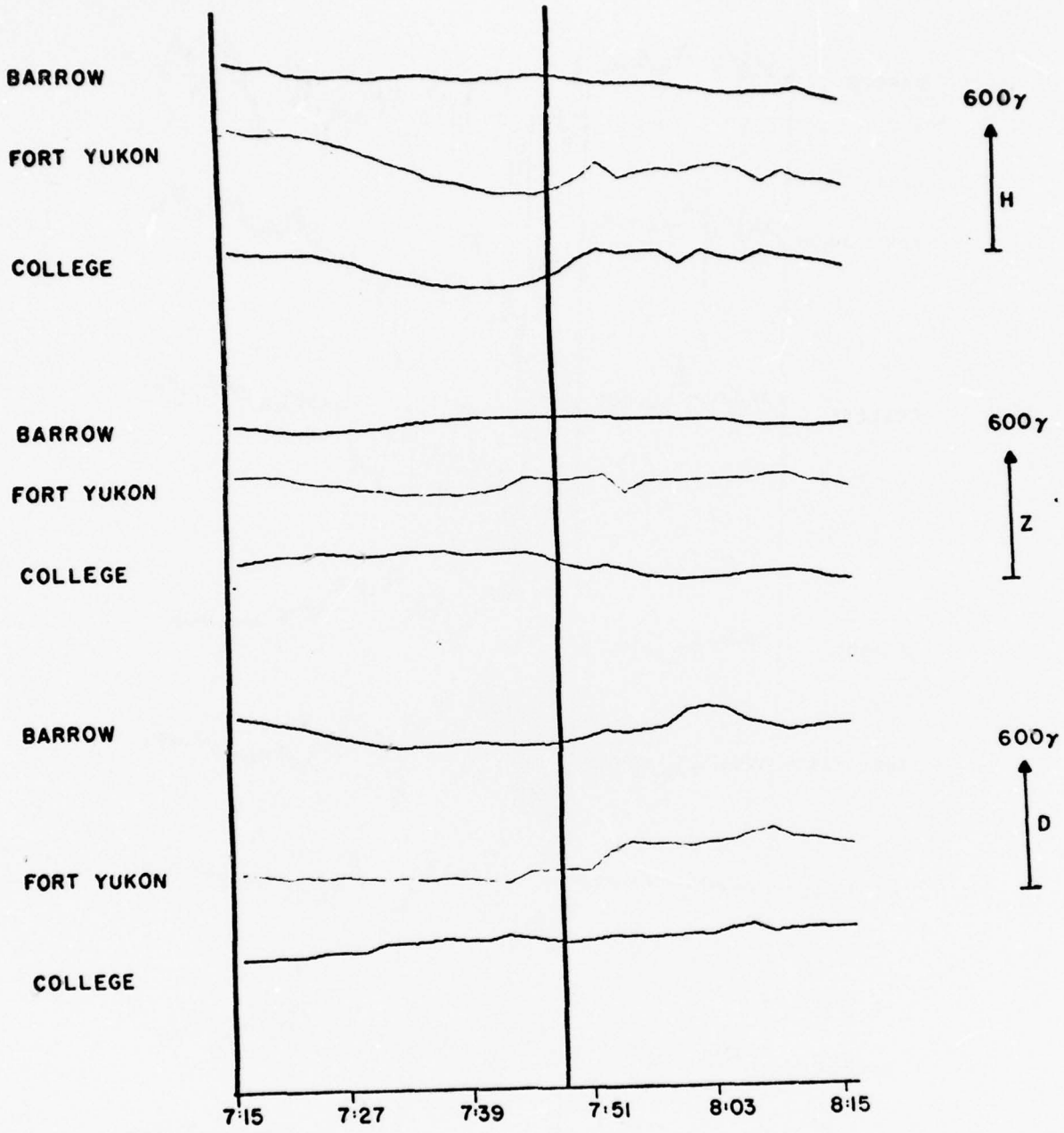


Figure 1b High Time Resolution Magnetometer Data from Various Locations.

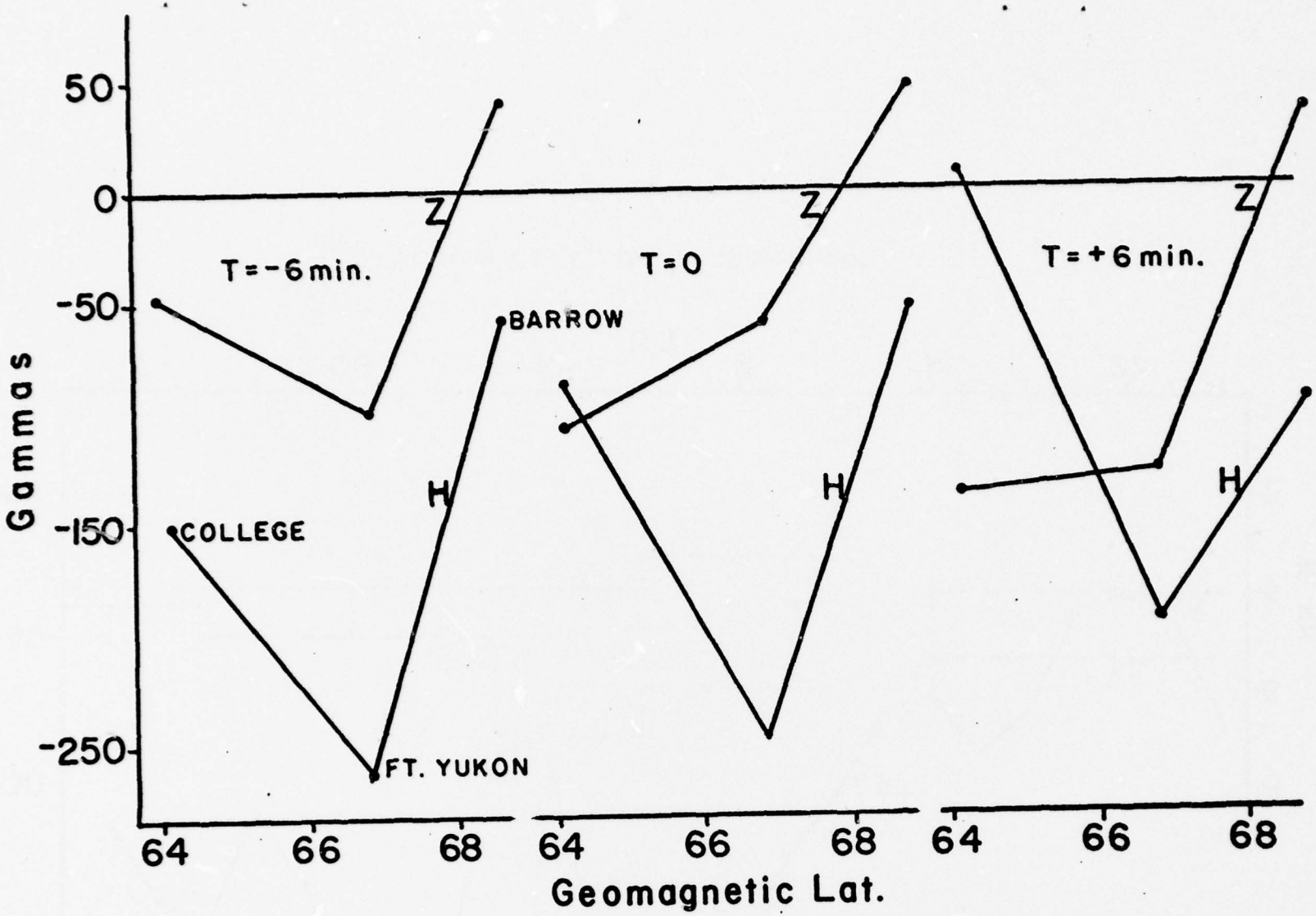


Figure 1c Variation of the Z and H Magnetic Components with Latitude.

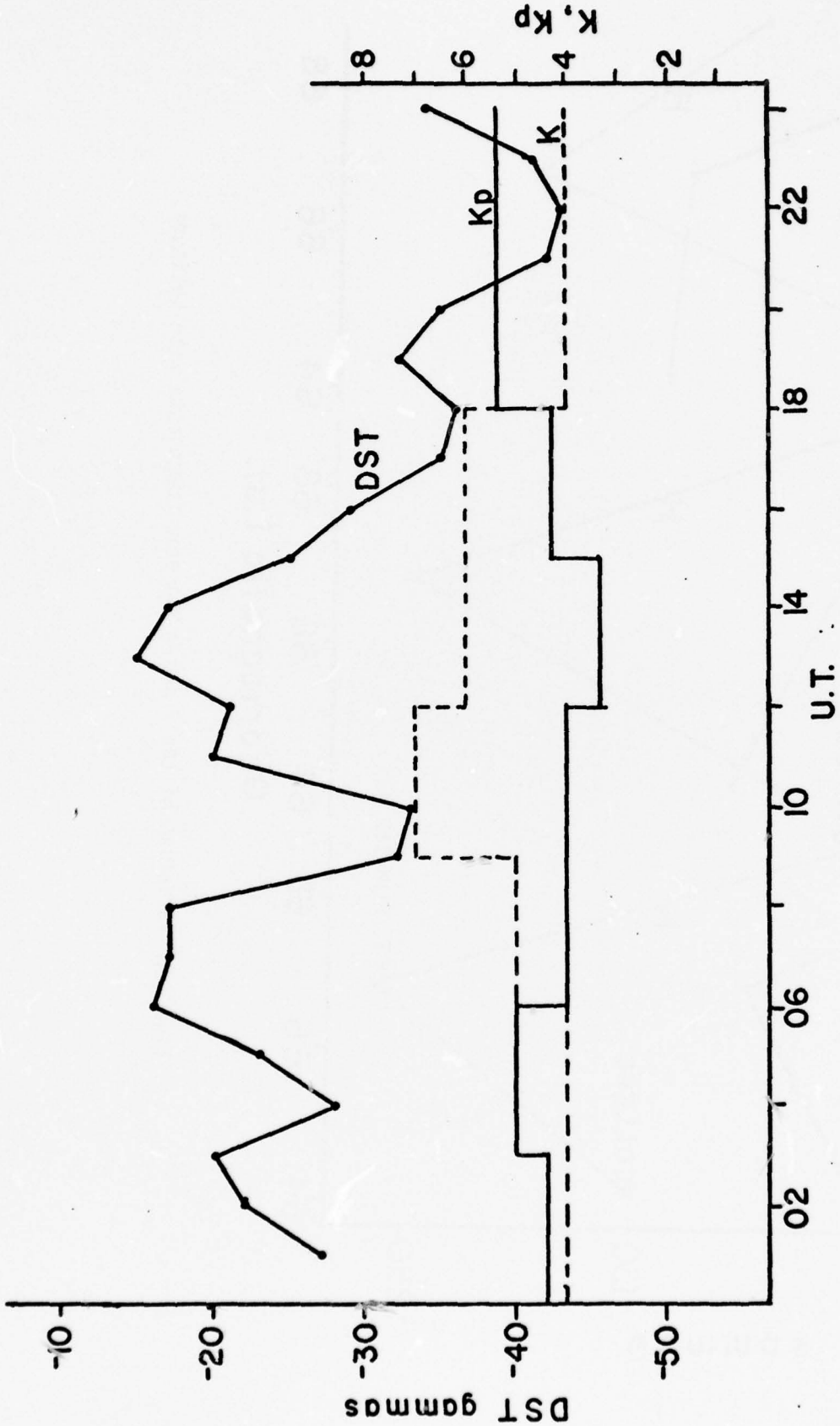


Figure 2 K, K_p, DST for 12 March 1975

associated with substorms occurring far to the east of the launch meridian. The main negative bay of -600 γ in ΔH occurred near 1000 UT March 12, some 2 hours after the launch.

The DST value, as seen from Figure 2, was between -18 γ and -35 γ during this launch, which implies using the data in Figure 3 that the cut-off trapping boundary for high energy electrons was poleward of College, but in a dynamic auroral period in which the boundary location is difficult to determine. The rocket traversed the region associated with the boundary between the eastward and westward electrojets.

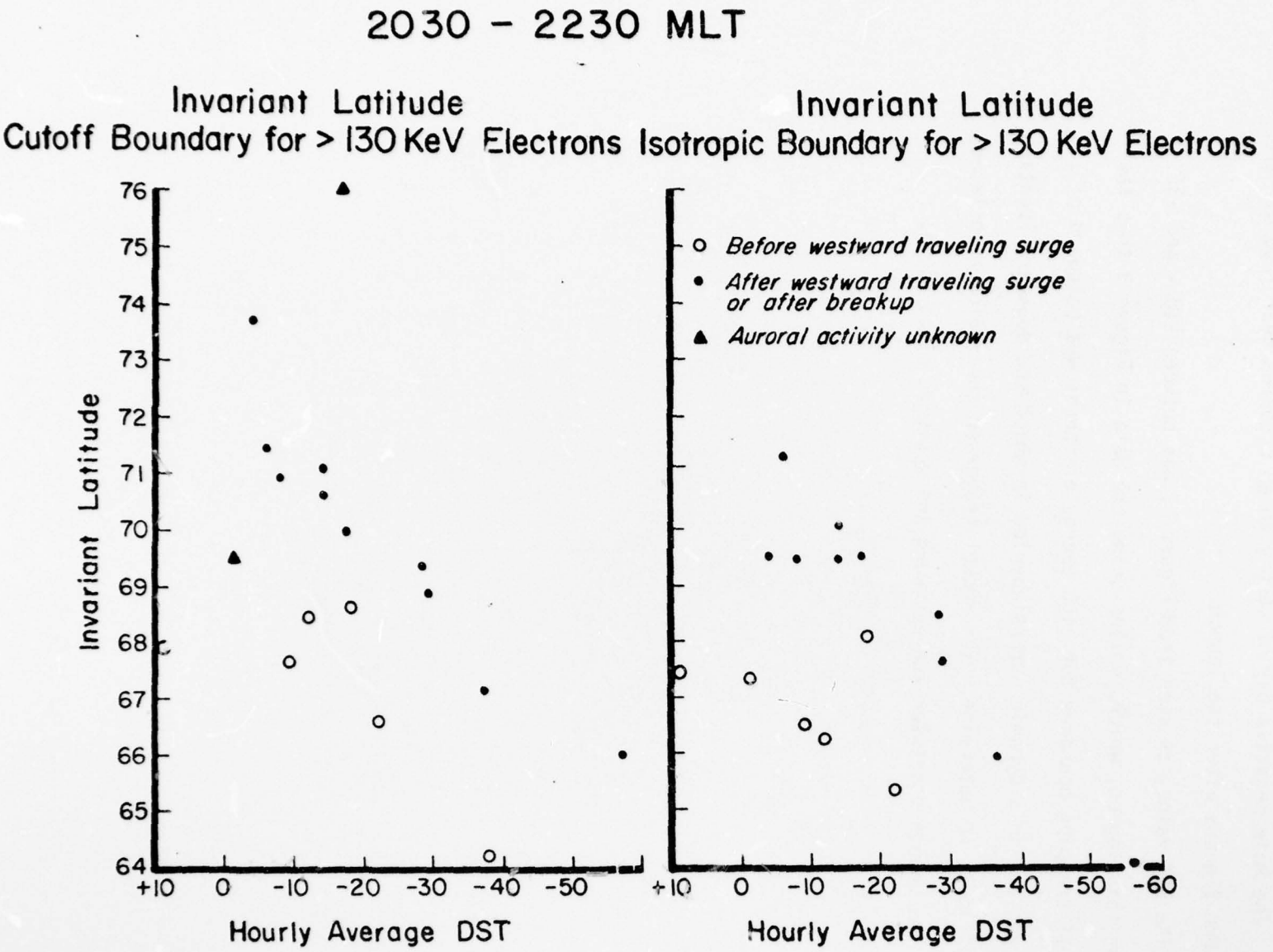


Figure 3 Latitudinal variation in the Trapping Boundaries for > 130 kev electrons in the Evening Sector of the Auroral Oval as a Function of Dst, Before or After Substorm Activity.

Section 5 - Radar Observations

During this period in the spring of 1975 the 50 MHz NOAA radar at Anchorage was in operation on a routine basis. Resumes of their data, instrumentation, and operational details are available from NOAA in Boulder, Colorado.

In addition, data from the Chatanika Incoherent Scatter radar are also available from SRI.

Any detailed study of the rocket data should incorporate a detailed examination of the available radar data. It is particularly applicable to the spatial structure of electron density irregularities, electric fields, neutral winds, and spatial and temporal dynamics of the particle precipitation.

Section 6 - All Sky Camera Observations

Table 9 lists the stations from which either 16mm or 35mm all sky camera and other instrument data are available during the period of interest on March 12, 1975. The auroral data quality from each site depends on the cloud coverage as indicated in Section 2.

Figure 4 is a composite of 35mm all sky camera photographs for the period prior to, during and after the launch of PF-SH-92.

The stations used were Ft. Yukon and Poker Flat. Time in UT as well as in seconds (or minutes) with respect to launch are indicated on each print.

From these photographs and a review of all of the data available, we describe the general auroral situation covering this rocket launch.

TABLE 9 Geophysical Instruments Operating
March 12, 1975

Chatanika

Incoh. Scat. Radar - 03:59-01:43 UT (13th)
35ASC - 06:00-16:10 UT
16ASC - patrol
Photometer - Not operating

Ester Dome

MSP - 05:47-09:50 UT
35ASC - 07:46-09:51 UT
16ASC - patrol
Hg - patrol

Fort Yukon

MSP - 07:00-09:45 UT
35ASC - 06:45-09:45 UT
16ASC - patrol
Riometer - Continuous
Magnetometer - Continuous

College

Riometer - Continuous
Magnetometer - Continuous

Poker Flat

TV - 07:48-07:58 UT
Magnetometer - Continuous
Riometer - Continuous

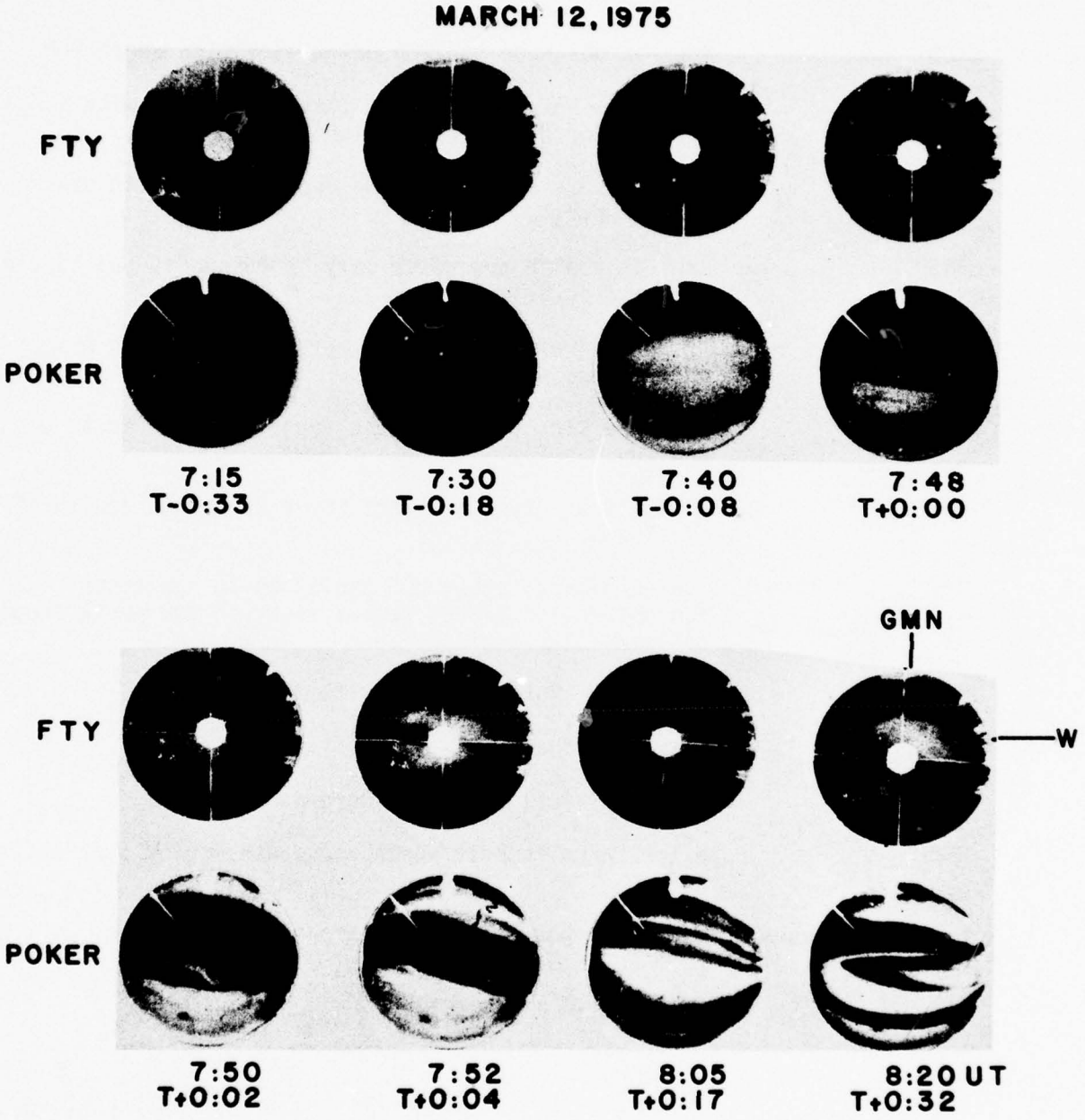


Figure 4 All-Sky Camera Data Prior To, During, and After Launch (Bright Aurora are Printed Black).

FORT YUKON

March 12, 1975

0600	Arcs on northern horizon below elevation angle 20°.
0650	Weak glow has moved to zenith at Ft. Yukon with arcs in north below elevation angle 20°.
0656	Arc develops near Ft. Yukon geographic zenith other arcs in north.
0718	Arcs in zenith and north vary in intensity but little substorm activity is seen.
0719-0730	Arc at 45° elevation angle north increases in brightness and becomes multiple.
0733	Multiple arcs begin to move south past Ft. Yukon zenith.
0742	Multiple arc system covers sky $\pm$ 45° about zenith at Ft. Yukon.
0750	System of arcs about 30° elevation in the south; another set of broken active forms in the north about 30° elevation angle.
0757	Sky at Ft. Yukon covered with multiple arcs.
0800	Sky full of aurora.
0830	Sky still full of active aurora.
0840	Bright arcs in both north and south - glow over whole sky.

Aurora continues active all night. The major break-up occurred at 0945 UT.

Section 7 - Meridian Scanning Photometer

Meridian scanning photometers were operated at Ester Dome and Ft. Yukon during this rocket launch. However, recording camera malfunction at Ester Dome prevents any use of these data. Table 10 gives the time variations of the 4278, 6300 and 5577 emissions as seen from Ft. Yukon for the 100 km entry and exit look angles as well as for auroral maxima in between. Figures 5a and 5b illustrate the intensity-time plots of the maximum and minimum values of the 4278, 6300 and 5577 emissions at Ft. Yukon. Figures 6a and 6b are intensity-time plots of 4278, 6300 and 5577 for the entry and exit look angles at Ft. Yukon. The Ft. Yukon intensity calibrations in kilo rayleighs in all 4 wavelengths are given in Table 11 in terms of voltage deflection. The MSP frame at typical auroral brightness during the launch as seen from Ft. Yukon is shown in Figure 7 along with the ordinate in -5 to +5 volt deflection units which can be converted to absolute intensity with the calibration curves in Table 11.

Figure 8 has the MSP data at Ft. Yukon scaled to the same size as the all sky camera data for the period during launch. Unfortunately, this is only useful as a qualitative comparison to illustrate the actual intensities of some of the main features on the all sky camera. In reality, the angular scale on the MSP is truly linear whereas that on the ASC is not linear in angle versus distance across the image. Thus, the two records may agree near the zenith but will not agree as the aurora increases in zenith angle. Also, the 35mm ASC is limited to an 80° zenith angle where the MSP data includes the horizons, so additional peaks may occur on the MSP data that do not occur on the ASC. However, in this case the relationship is quite straightforward.

FORT YUKON MARCH 12, 1975

UT TIME	T(SEC)	100KM ENTRY ELV	5577	4278	6300	MAXIMUM ELV	5577	4278	6300	100KM EXIT ELV	5577	4278	6300	MINIMUM ELV	5577	4278	6300
7-42- 6	-364	150	6.3	1.0	0.7	126	16.9	2.3	1.0	118	12.2	1.8	1.2	136	4.9	0.8	0.8
7-42-27	-343	150	6.3	1.1	0.8	128	23.4	2.9	1.1	118	12.2	2.1	1.4	134	5.4	0.9	0.8
7-42-49	-321	150	5.8	1.0	0.8	127	23.4	2.9	1.4	118	13.3	2.1	1.4	127	4.9	0.8	0.8
7-43-10	-300	150	6.3	0.9	0.8	130	25.3	3.1	1.1	118	14.4	2.1	1.4	140	5.4	0.8	0.8
7-43-31	-279	150	7.5	1.2	0.7	132	27.5	4.0	1.0	118	15.6	2.3	1.4	145	5.8	1.1	0.7
7-43-53	-257	150	6.9	1.1	1.0	137	25.3	3.7	1.1	118	15.6	2.4	1.5	142	5.8	1.1	1.0
7-44-14	-236	150	7.5	1.2	1.0	135	25.3	2.9	1.1	118	14.4	2.1	1.5	142	5.8	1.0	1.1
7-44-35	-215	150	5.4	0.9	0.7	140	27.5	3.7	1.0	118	12.2	1.8	1.4	150	5.4	0.9	0.7
7-44-57	-193	150	5.8	1.1	0.8	138	25.3	3.7	1.1	118	12.2	1.8	1.4	145	5.4	1.0	1.0
7-45-18	-172	150	6.3	1.1	0.8	138	25.3	2.9	1.1	118	8.1	1.2	1.2	145	5.8	0.9	0.8
7-45-39	-151	150	6.3	0.9	0.7	140	25.3	2.9	1.0	118	8.8	1.3	1.1	145	5.8	0.9	0.8
7-46- 1	-129	150	6.3	1.0	0.8	136	25.3	3.1	1.1	118	10.4	1.5	1.4	145	5.8	0.9	1.0
7-46-22	-108	150	6.9	1.2	1.0	140	25.3	2.9	1.4	118	11.3	1.6	1.4	145	6.3	1.2	1.0
7-46-43	-87	150	7.5	1.2	0.8	140	23.4	2.7	1.1	118	11.3	1.5	1.4	145	6.3	1.2	1.0
7-47- 5	-65	150	6.3	1.1	0.8	140	25.3	3.1	1.1	118	11.3	1.3	1.4	150	6.3	1.1	0.8
7-47-26	-44	150	8.1	1.1	0.8	138	25.3	3.1	1.4	118	11.3	1.5	1.4	150	8.1	1.1	0.8
7-47-47	-23	150	7.5	0.9	0.8	138	25.3	2.9	1.4	118	9.6	1.0	1.2	150	7.5	0.9	0.8
7-48- 9	-1	150	11.3	1.8	1.2	140	27.5	4.0	1.6	118	11.3	1.8	1.6	120	10.4	1.8	1.9
7-48-30	20	150	10.4	1.3	1.1	143	23.4	2.9	1.4	118	11.3	1.6	1.5	150	10.4	1.3	1.1
7-48-51	41	150	12.2	1.6	1.0	140	16.9	2.1	1.2	118	6.9	0.9	1.2	118	6.9	0.9	1.2
7-49-13	63	150	5.4	0.8	1.9	130	13.3	1.9	1.1	118	7.5	0.9	1.4	150	5.4	0.8	1.9
7-49-34	84	150	12.2	1.6	1.0	140	18.3	2.1	1.2	118	12.2	1.8	1.4	122	8.8	1.2	1.5
7-49-56	106	150	12.2	1.8	1.2	145	25.3	2.7	1.4	118	9.6	1.3	1.5	118	9.6	1.3	1.5
7-50-17	127	150	12.2	1.5	1.1	145	25.3	2.4	1.4	118	7.5	1.1	1.4	118	7.5	1.1	1.4
7-50-38	148	150	12.2	1.9	1.5	145	35.0	5.1	1.9	118	10.4	1.9	1.9	118	10.4	1.9	1.9
7-51- 0	170	150	10.4	1.5	1.0	142	25.3	3.1	1.5	118	8.8	1.0	1.4	118	8.8	1.0	1.4
7-51-21	191	150	12.2	1.5	1.1	142	27.5	3.4	1.5	118	6.3	0.9	1.2	118	6.3	0.9	1.2
7-51-42	212	150	12.2	1.9	1.1	142	25.3	3.1	1.5	118	5.8	0.9	1.4	118	5.8	0.9	1.4
7-52- 4	234	150	12.2	1.6	1.0	145	25.3	2.7	1.4	118	5.4	0.7	1.1	118	5.4	0.7	1.1
7-52-25	255	150	8.1	1.3	1.0	145	25.3	2.7	1.5	118	4.5	0.7	1.1	118	4.5	0.7	1.1
7-52-46	276	150	12.2	1.5	1.0	142	25.3	2.9	1.4	118	4.2	0.7	1.1	118	4.2	0.7	1.1
7-53- 8	298	150	12.2	1.6	1.0	140	25.3	3.7	1.8	118	3.5	0.7	1.2	118	3.5	0.7	1.2
7-53-29	319	150	8.8	1.3	1.0	140	29.8	3.7	1.5	118	4.5	0.8	1.2	118	4.5	0.8	1.2
7-53-51	341	150	11.3	1.8	1.1	140	29.8	4.0	1.5	118	4.9	0.9	1.4	118	4.9	0.9	1.4
7-54-12	362	150	12.2	1.8	1.0	142	27.5	3.4	1.4	118	4.2	0.7	1.2	118	4.2	0.7	1.2
7-54-33	383	150	14.4	2.1	1.1	145	32.3	3.7	1.5	118	4.5	0.7	1.2	120	4.2	0.7	1.4
7-54-55	405	150	27.5	3.7	1.1	145	32.3	4.0	1.4	118	4.9	0.7	1.1	120	4.2	0.7	1.2
7-55-16	426	150	52.3	5.5	1.5	150	52.3	5.5	1.5	118	5.8	0.8	1.1	120	4.9	0.8	1.4
7-55-37	447	150	37.9	4.3	1.5	150	37.9	4.3	1.5	118	4.5	0.7	1.1	118	4.5	0.7	1.1
7-55-59	469	150	44.5	5.5	1.5	150	44.5	5.5	1.5	118	4.9	0.8	1.4	118	4.9	0.8	1.4
7-56-20	490	150	27.5	3.7	1.6	150	27.5	3.7	1.6	118	3.8	0.7	1.2	118	3.8	0.7	1.2
7-56-41	511	150	23.4	3.1	1.5	150	23.4	3.1	1.5	118	5.4	0.8	1.4	118	5.4	0.8	1.4
7-57- 3	533	150	25.3	3.1	1.5	150	25.3	3.1	1.5	118	5.4	0.8	1.2	122	4.9	0.7	1.8

Table 10 Time Variations of the 4278, 5577 and 6300 Emissions at the 100 km Rocket Entry and Exist Look Angles for Ft. Yukon and at Auroral Maxima in Between.

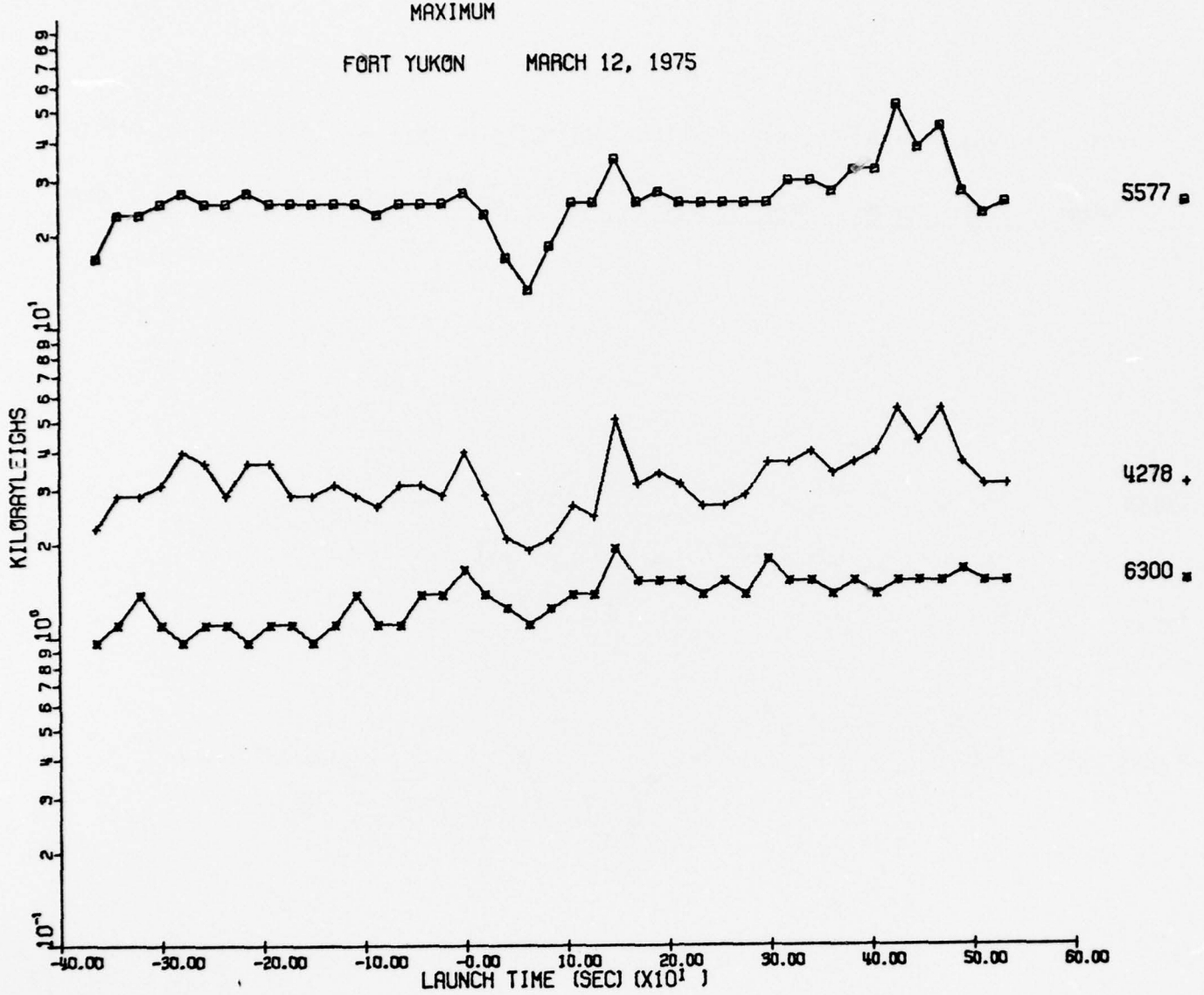


Figure 5a Intensity Time Plot of 4278, 5577 and 6300 Emission Maxima for Ft. Yukon.

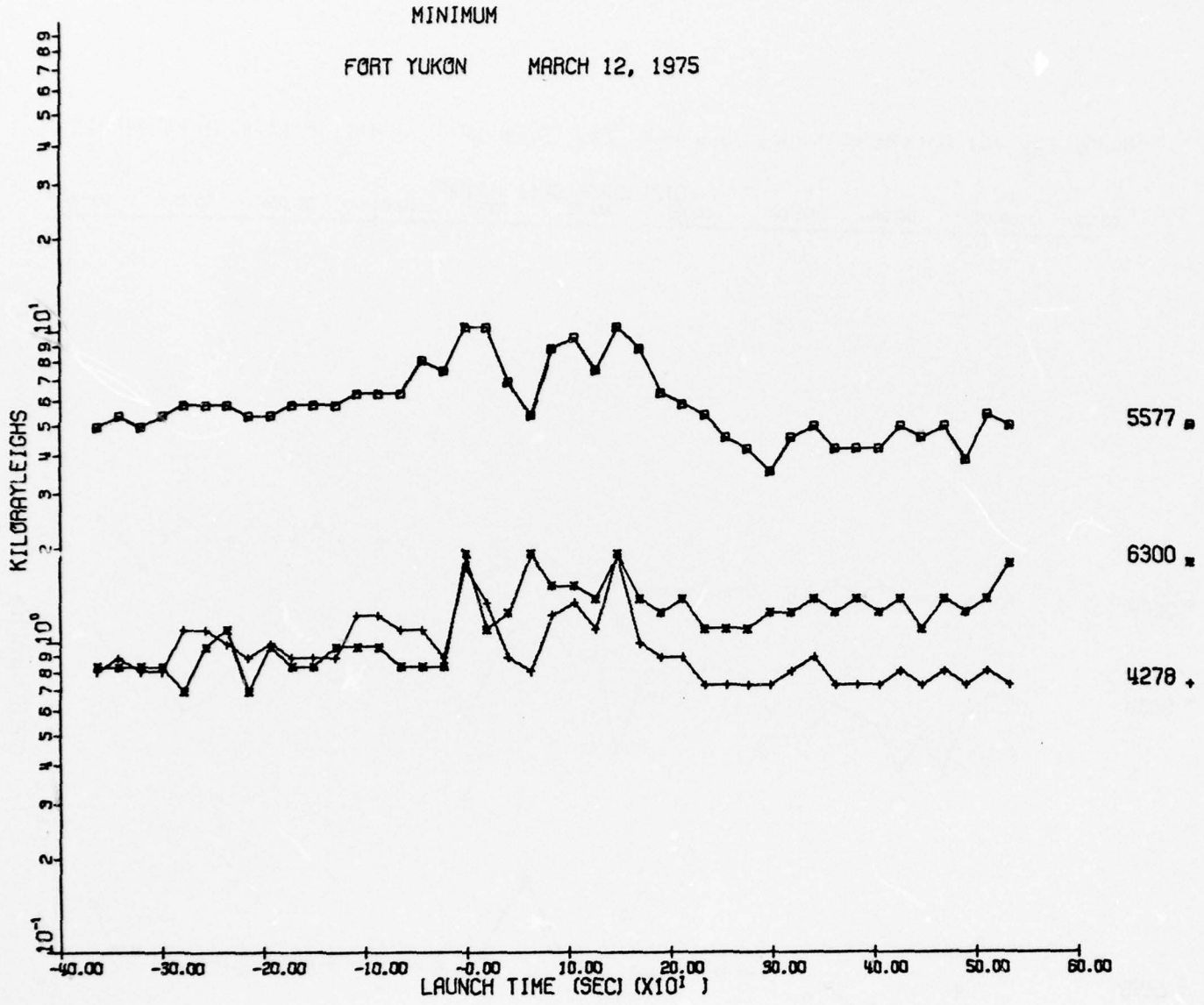


Figure 5b Intensity Time Plot of 4278, 5577 and 6300 Emission Minima for Ft. Yukon.

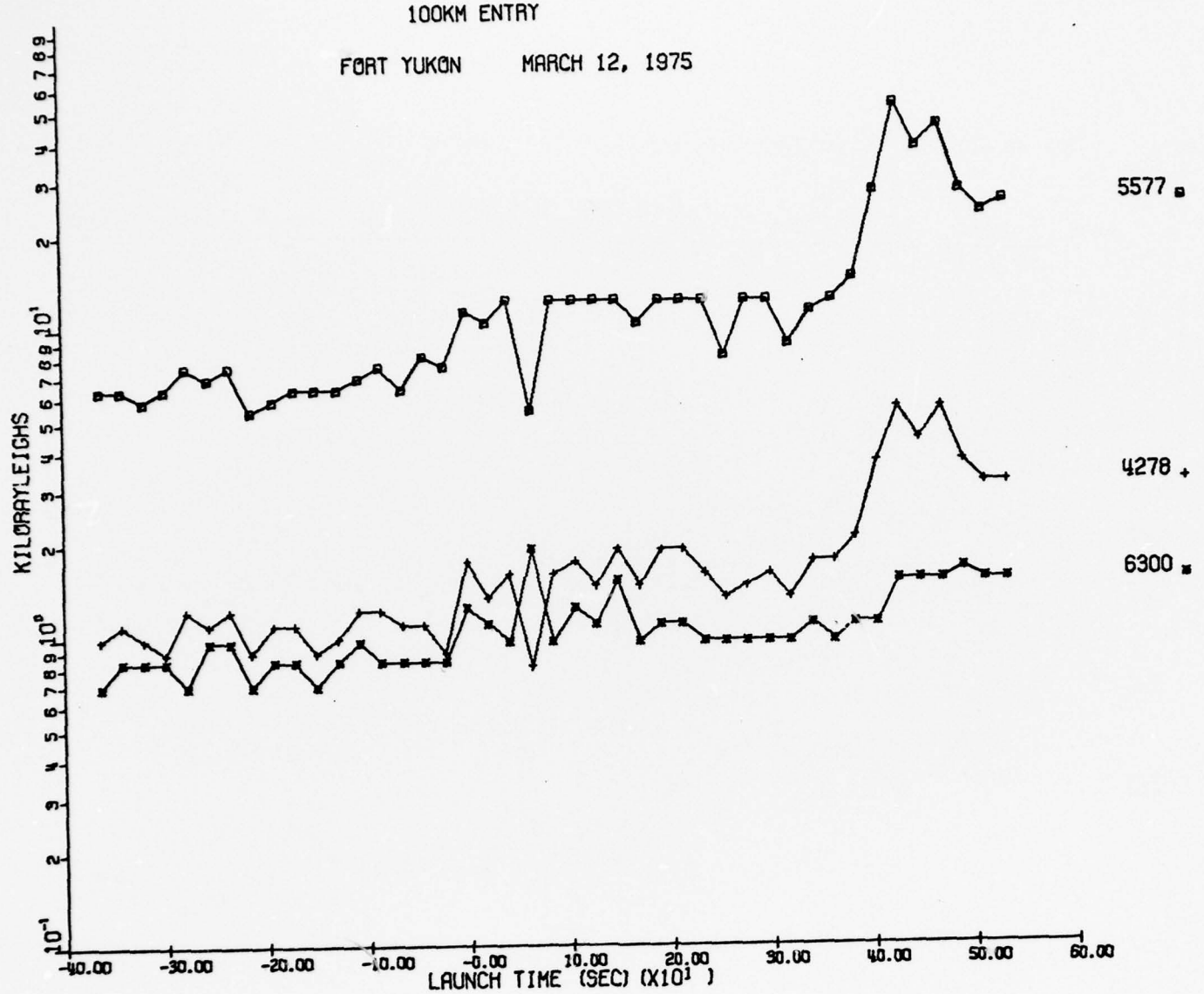


Figure 6a Entry Look Angle 4278, 5577 and 6300 Intensity-Time Curves for Ft. Yukon.

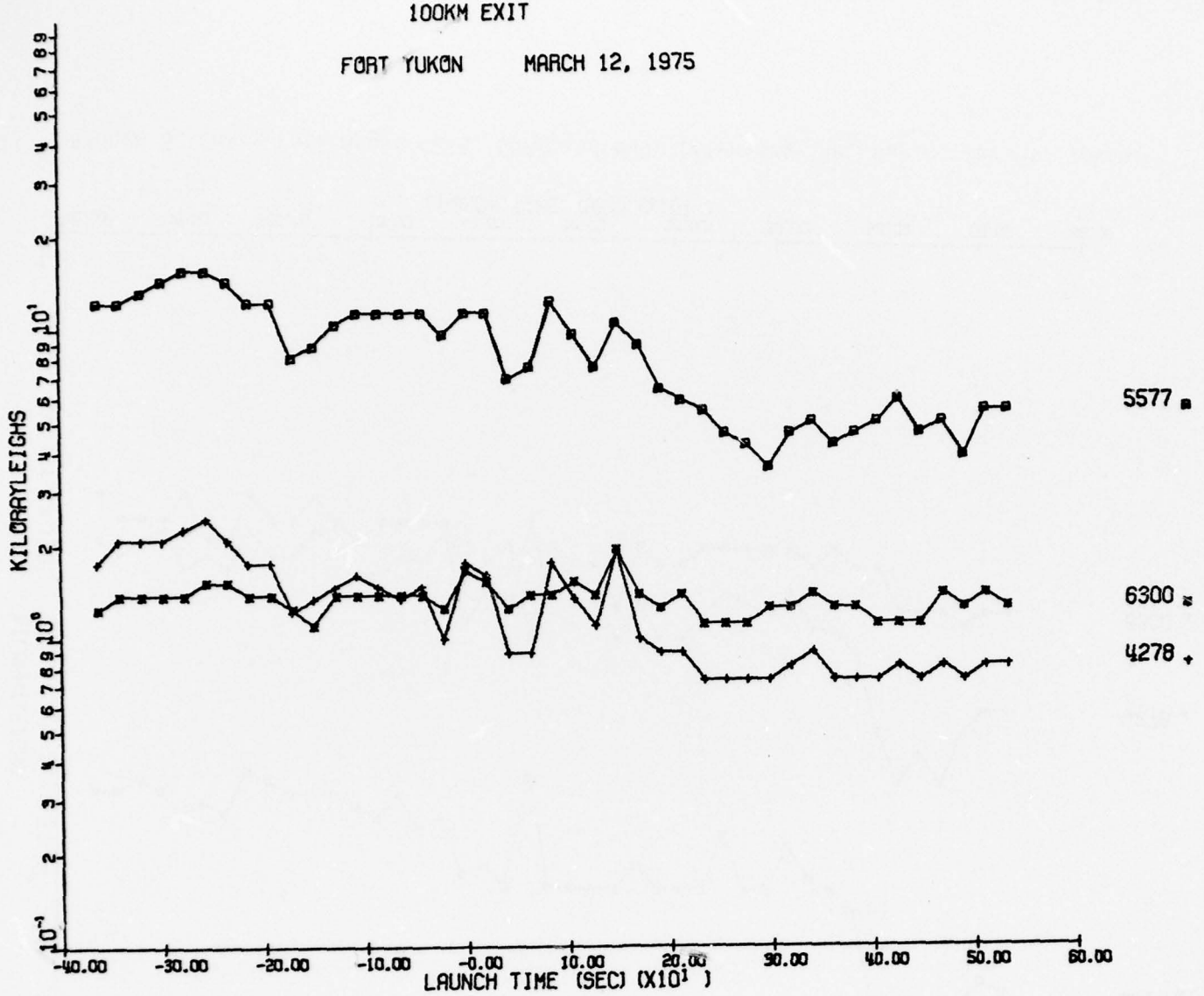


Figure 6b 100 km Exit Look Angle 4278, 5577 and 6300 Intensity-Time Curves for Ft. Yukon.

TABLE 11 Intensity Calibrations (kR) Ft. Yukon

Voltage	5577	4278	6300	H Beta
-5.00	0	0	0	0
4.75	.128	.051	.33	.011
4.50	.160	.112	.66	.022
4.25	.199	.164	1.00	.035
-4.00	.251	.234	1.33	.047
3.75	.318	.318	1.67	.058
3.50	.397	.42	2.00	.070
3.25	.488	.49	2.35	.082
-3.00	.613	.772	2.67	.094
2.75	.774	.98	3.00	.106
2.50	.978	1.26	3.34	.118
2.25	1.22	1.54	3.68	.127
-2.00	1.53	1.92	4.01	.141
1.75	1.94	2.34	4.35	.151
1.50	2.40	2.91	4.70	.165
1.25	2.96	3.51	5.04	.174
-1.00	3.67	4.35	5.36	.188
0.75	4.54	5.38	5.71	.198
0.50	5.61	6.46	6.03	.212
0.25	6.95	7.81	6.38	.224
0	8.6	9.60	6.70	.235
+0.25	10.6	11.7	7.05	.247
0.50	13.2	14.5	7.37	.258
0.75	16.3	17.8	7.71	.270
+1.00	20.2	21.5	8.06	.282
1.25	25.0	26.2	8.38	.291
1.50	30.9	32.3	8.73	.306
1.75	38.2	38.8	9.05	.317
+2.00	47.3	47.7	9.39	.329
2.25	58.5	58.5	9.74	.341
2.50	72.4	71.1	10.08	.353
2.75	89.7	86.6	10.40	.364
+3.00	111	108	10.73	.376
3.25	137		11.10	
3.50	190		11.42	(Average of
3.75	210		11.76	H and V
+4.00	260	236	12.06	profiles)
4.25	322			
4.50	399			
4.75	493			
+5.00	611	468		

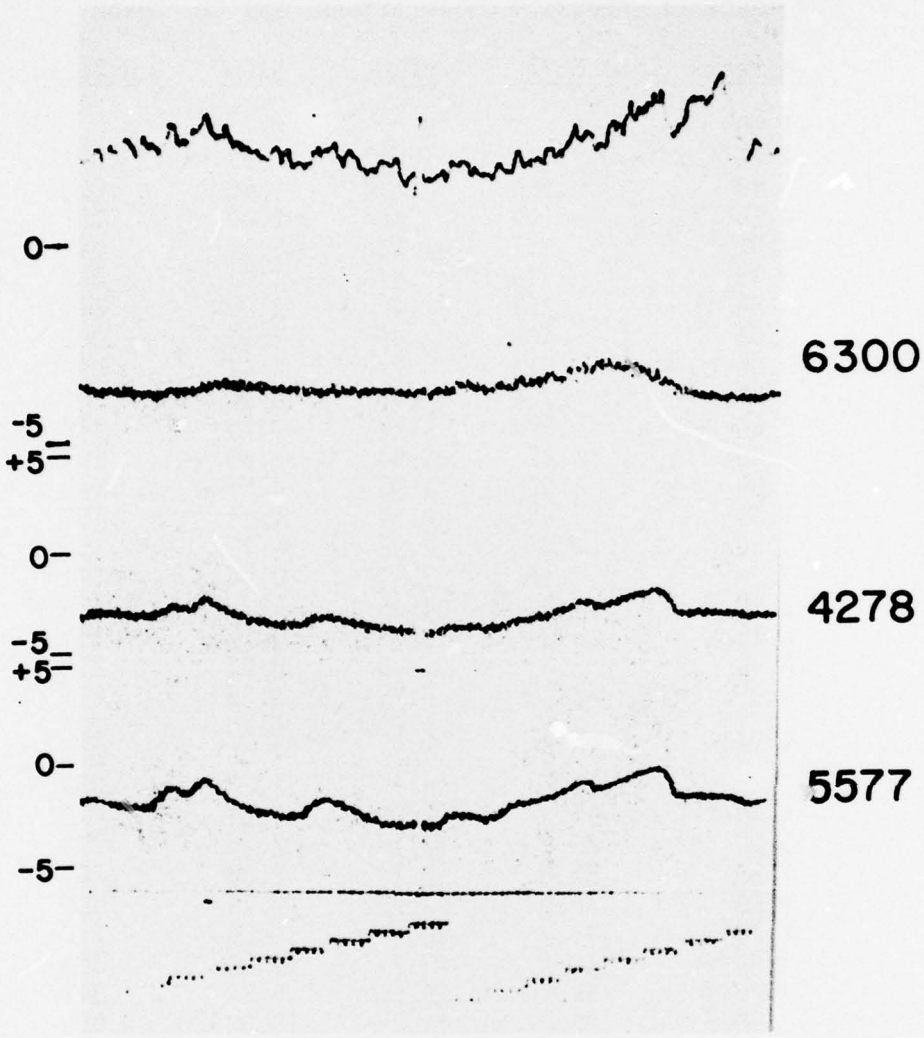


Figure 7 MSP Frame from Ft. Yukon at Typical Auroral Brightness During Launch.

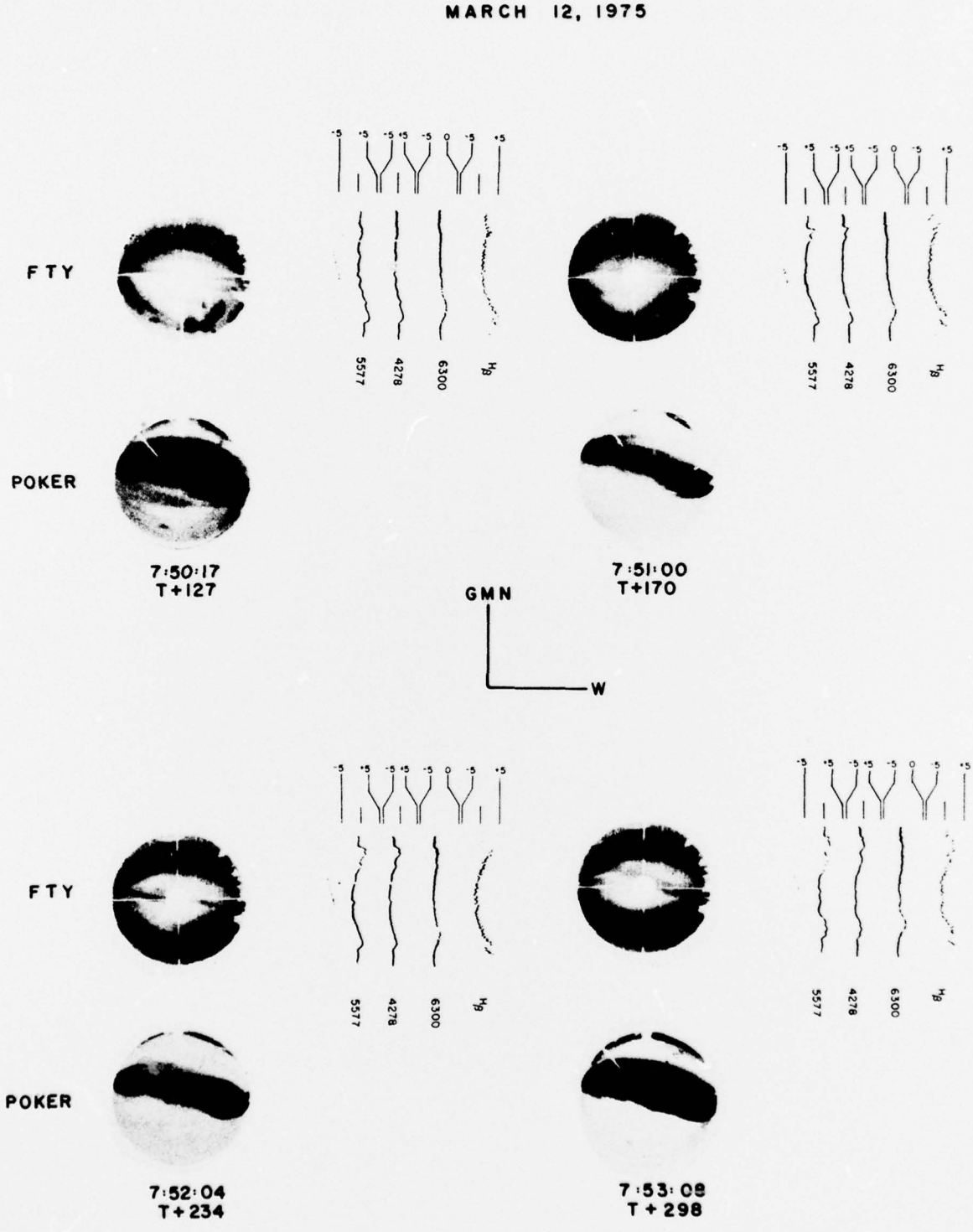


Figure 8 Composite of 35mm ASC and Meridian Scanning Photometer Data (MSP Records from Ft. Yukon).

Section 8 - Television Coverage

Television data from Ester Dome were obtained during this rocket launch.

Section 9 - Riometer Data

Riometers are operated at Ft. Yukon, College and Poker Flat. Absorption is measured at 30 MHz. Figure 9 shows the records from Ft. Yukon and Poker Flat from 06:30 to 11:00 UT on March 12, 1975. There was not much absorption during the time interval of interest which indicates that high energy particles probably were not precipitating during this rocket flight. The exact values of absorption are accurate to $\pm$ 2 db for this level of activity.

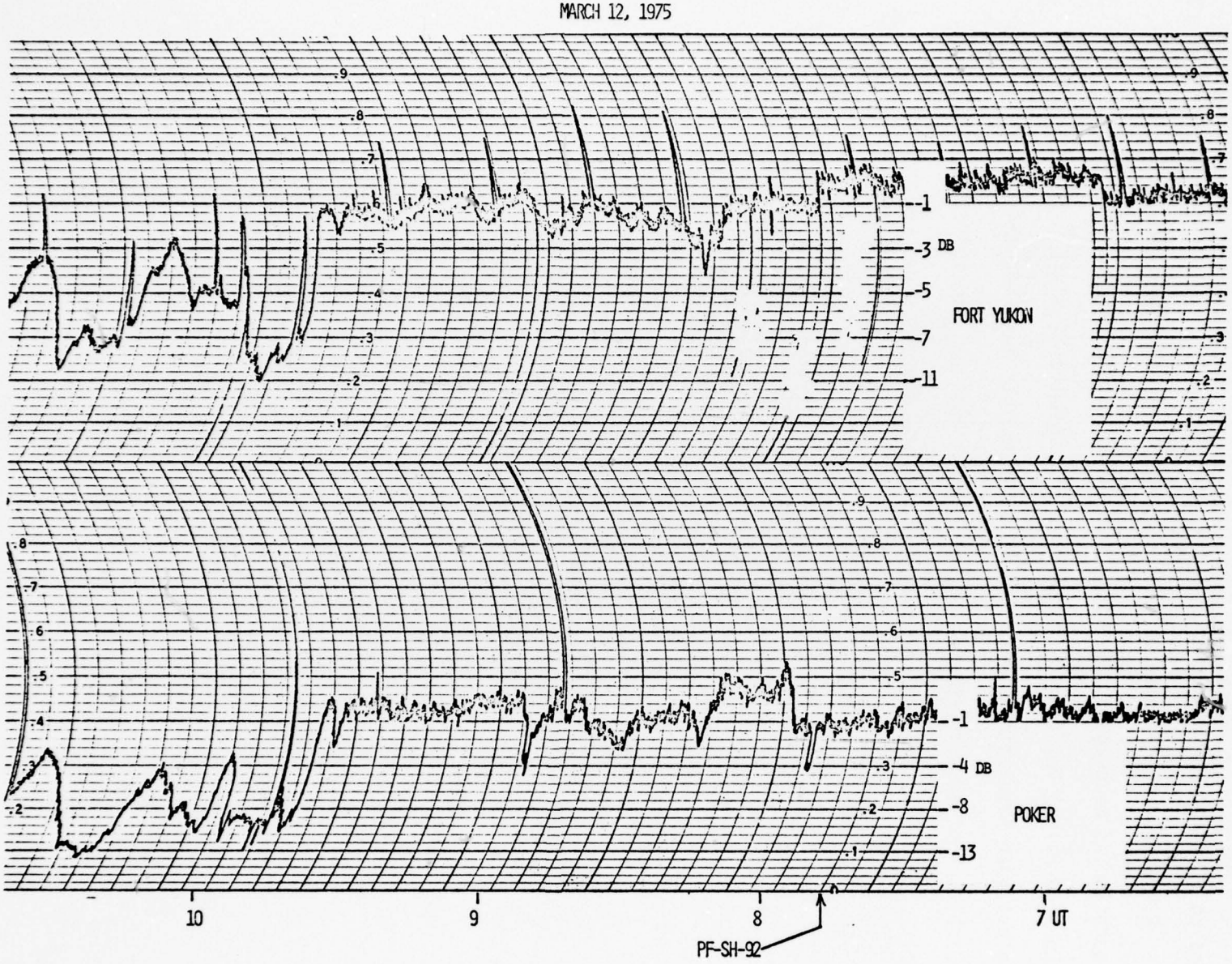


Figure 9 Riometer Asborption from Poker Flat and Ft. Yukon

Section 10 - Ionosonde Data

The ionosonde at College operates between .5 and 20 MHz at vertical incidence. It requires approximately 30 seconds to sweep over the complete frequency range and is normally programmed to operate once every 15 minutes, on the minute. Data for the three periods closest to the launch are presented here in Figure 10. The earliest record at 07:30 shows complicated layer structures with little indication of absorption and maxima E-layer densities around 4.2×10^5 electrons/cm^3.

The second record at 07:45 shows increased absorption and enhanced E region electron densities to 1.2×10^6 electrons/cm^3. There is little E region structure and is a thinner layer than previously.

The third record at 08:00 shows a decrease in absorption with E region electron density around 7.9×10^5 electrons/cm^3. The layer has become even thinner than the previous record with enhanced E region structure. A meteor echo is shown between 6 and 10 MHz at 120 km VH.

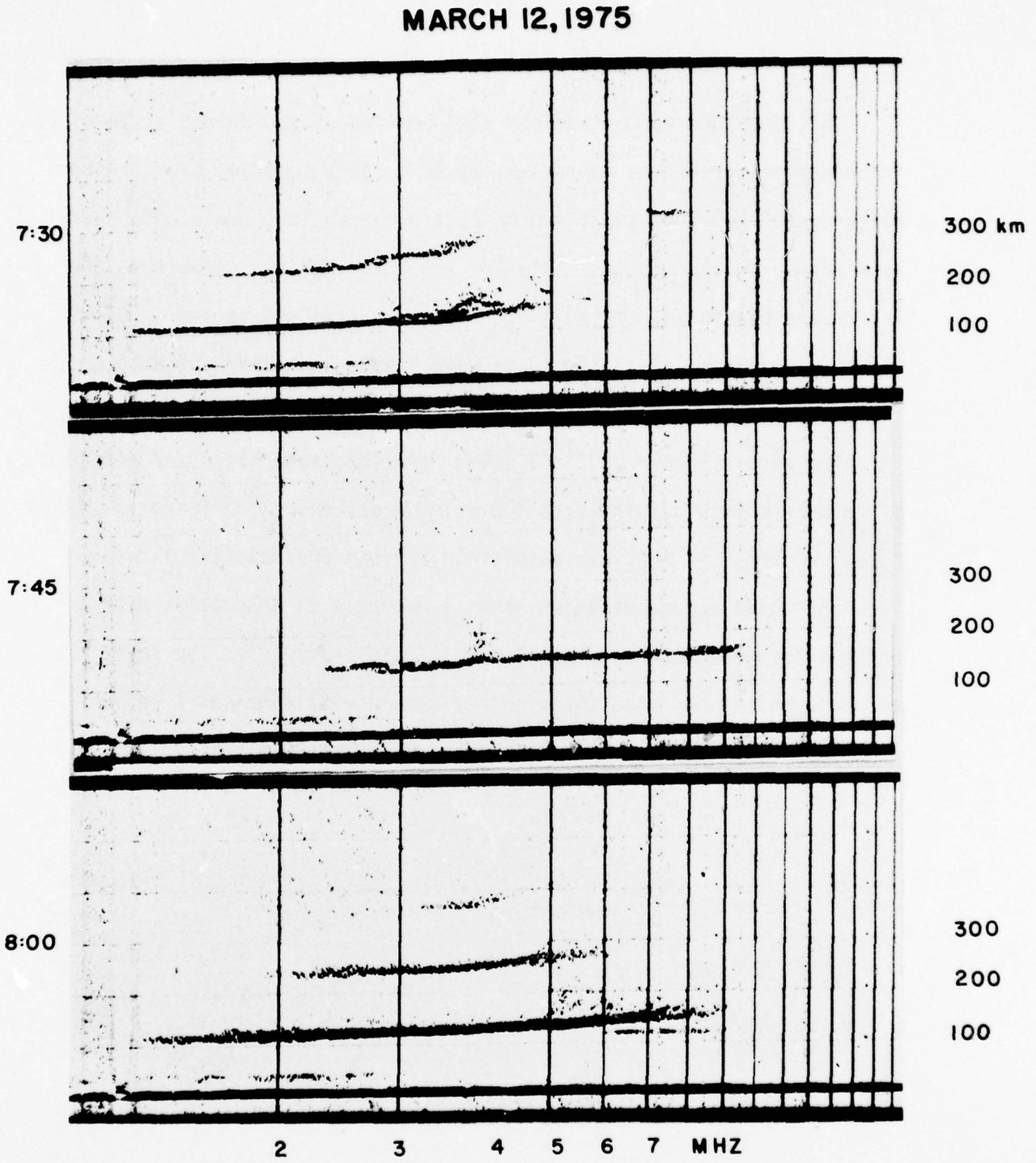


Figure 10 Ionosonde Data from College

Section 11 - DMSP Satellite Photographic Data

The Air Force weather DMSP satellites record auroral activity on nighttime passes over the auroral zone. We have included in Figure 11 the closest satellite pass to the launch of Rocket PF-SH-92. The aurora seen on this photograph covers the period 0819 UT to 0821 UT. A map of Alaska is superimposed on the satellite photograph for orientation purposes. The satellite orbit passed along the center of the original photograph approximately through the northernmost point along the Alaska-Canadian border, and consequently almost along the launch azimuth of the rocket. The rocket launch occurred prior to the satellite passage over the same latitude, thus these DMSP data can be used to help describe the general type of activity after launch. These data illustrate the presence of surge activity propagating westward due to substorm activity farther to the east.

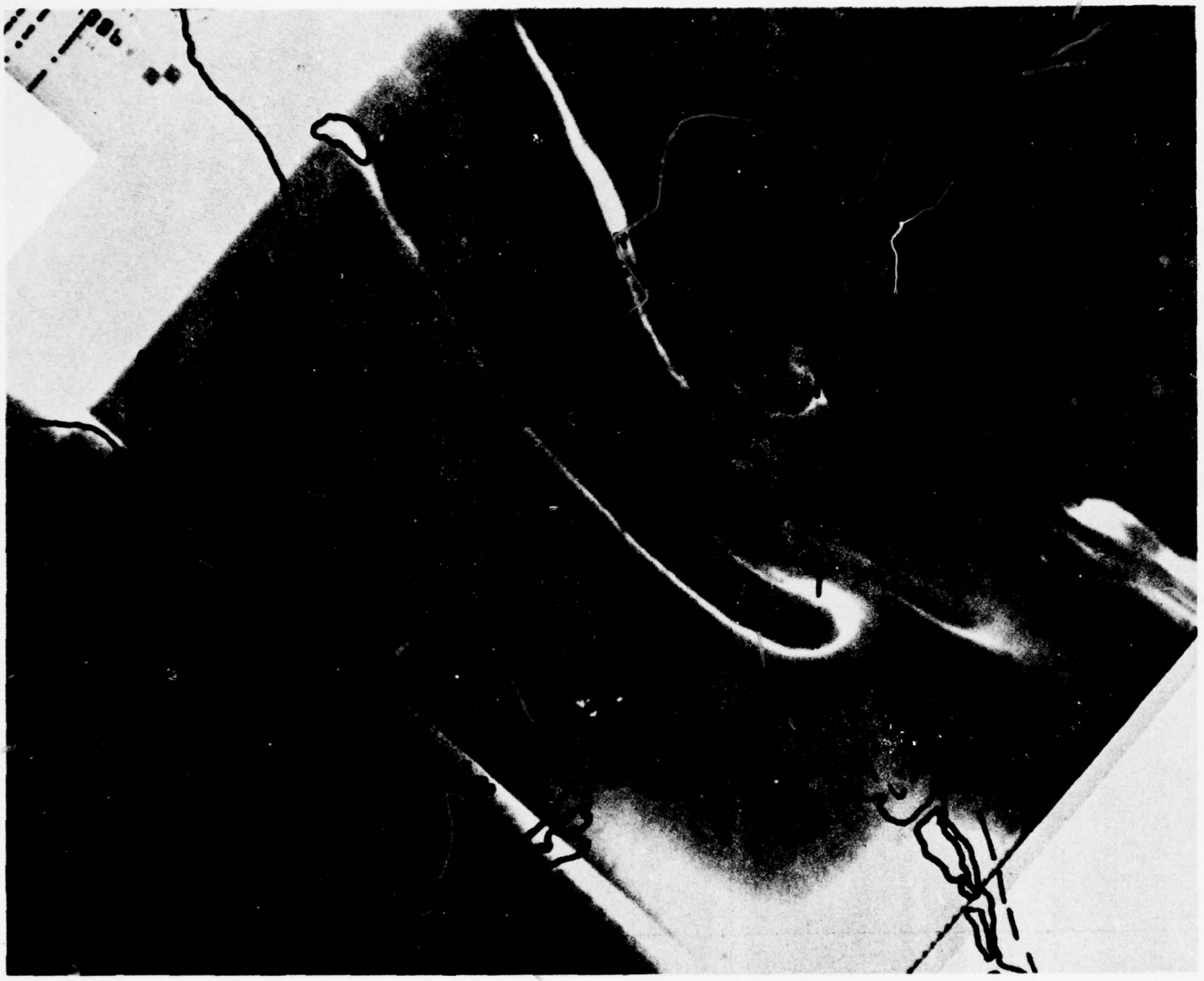


Figure 11 DMSP Satellite Photograph at 08:19-08:21 UT, March 12, 1975.

References

Akasofu, S.-I., Polar and Magnetospheric Substorms, D. Reidel Publishing Company, Dordrecht, Holland, 1968.